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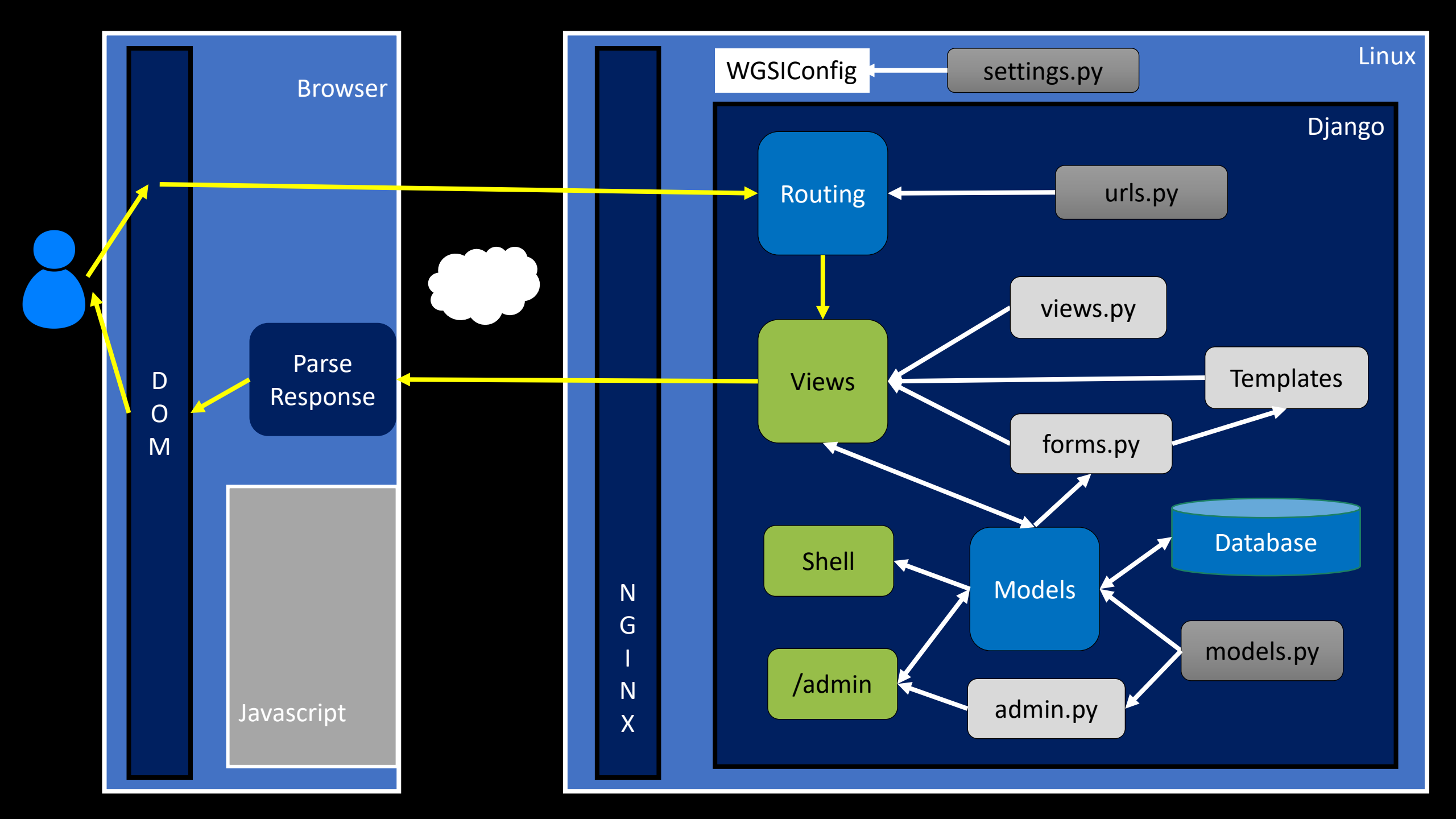
This slide deck consists of slides used in 2 lecture videos in Week 1. Below is a list of shortcut hyperlinks for you to jump into specific sections.

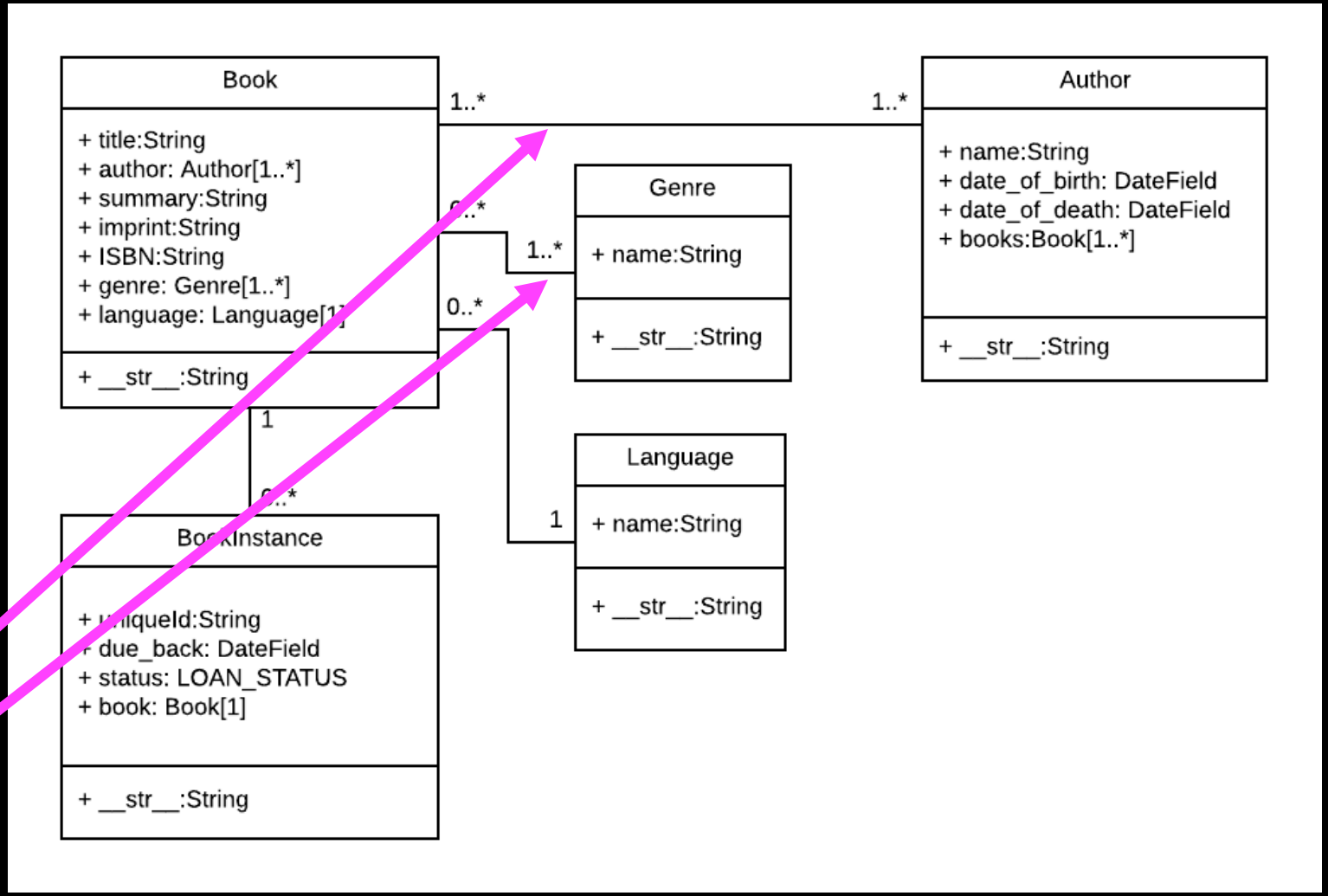
Charles Severance
www.dj4e.com

Data Modelling Many to Many

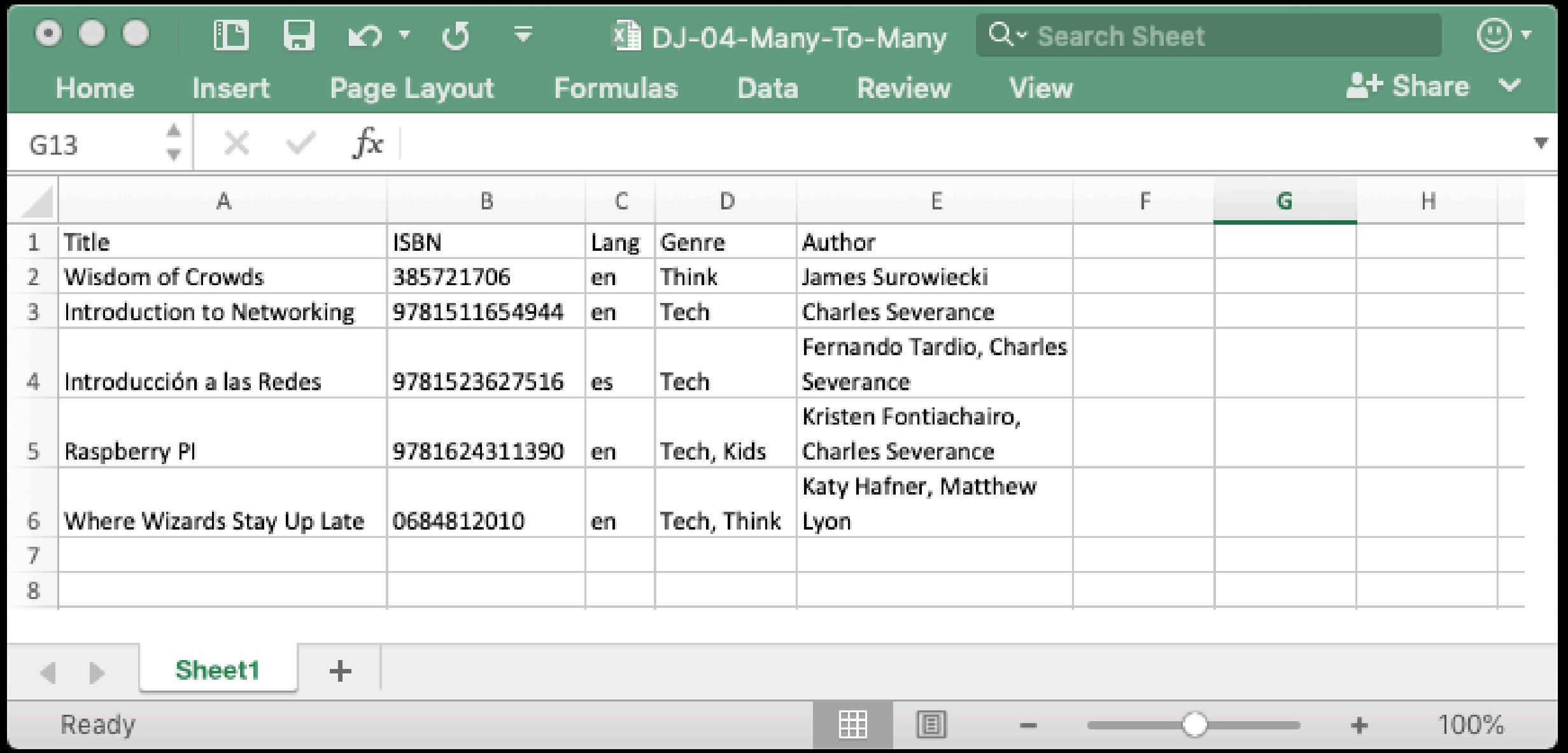

Browser
DOM
Parse Response
Javascript
NGINX
WGSIConfig
settings.py
Linux
Django
Routing
urls.py
views.py
Views
Templates
forms.py
Shell
Models
Database
models.py
/admin
admin.py

Many-to-Many

"The relationships between Book / Genre and Book / Author are many-to-many"



https://developer.mozilla.org/en-US/docs/Learn/Server-side/Django/Models



	A	B	C	D	E	F	G	H
1	Title	ISBN	Lang	Genre	Author			
2	Wisdom of Crowds	385721706	en	Think	James Surowiecki			
3	Introduction to Networking	9781511654944	en	Tech	Charles Severance			
4	Introducción a las Redes	9781523627516	es	Tech	Fernando Tardio, Charles Severance			
5	Raspberry PI	9781624311390	en	Tech, Kids	Kristen Fontiachairo, Charles Severance			
6	Where Wizards Stay Up Late	0684812010	en	Tech, Think	Katy Hafner, Matthew Lyon			
7								
8								

Many-To-Many

Title	ISBN	Genre	Author
Wisdom of Crowds	385721706	Think	James Surowiecki
Introduction to Networking	9781511654944	Tech	Charles Severance
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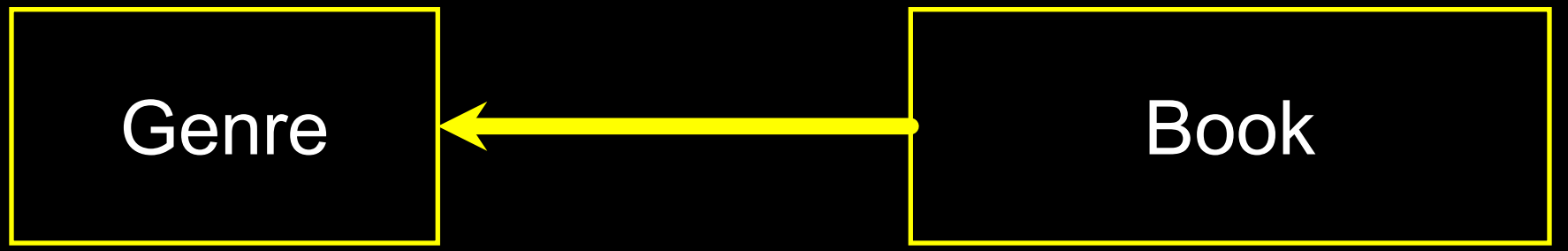
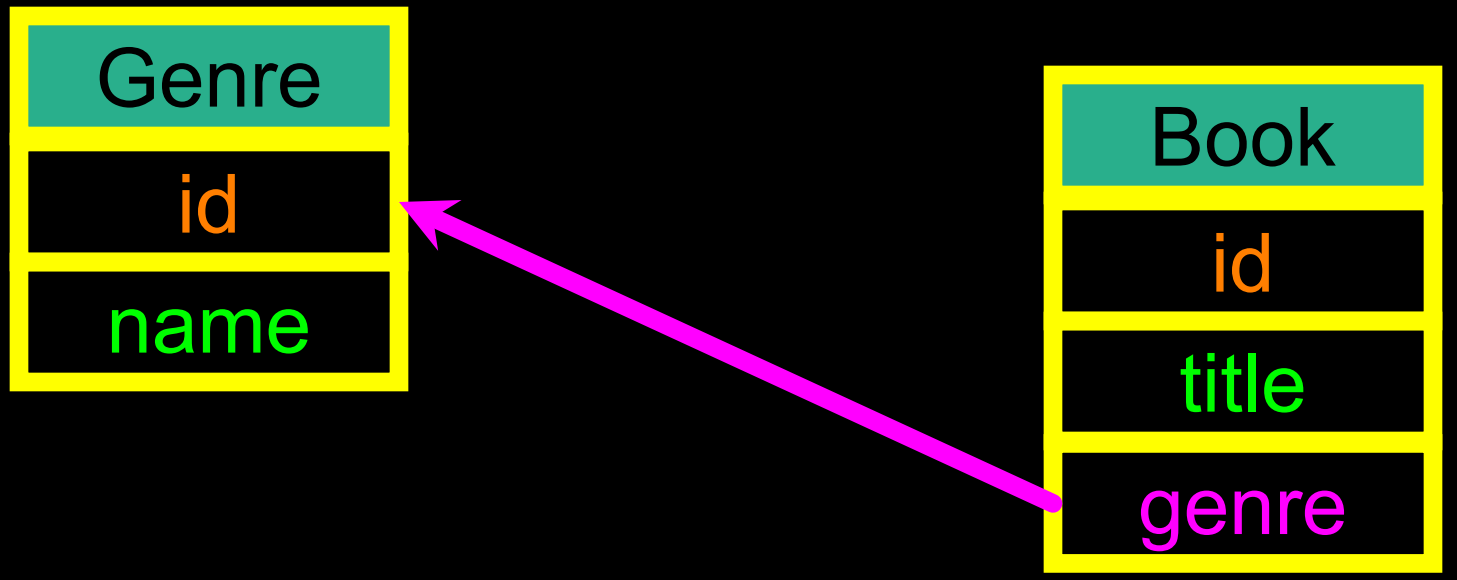
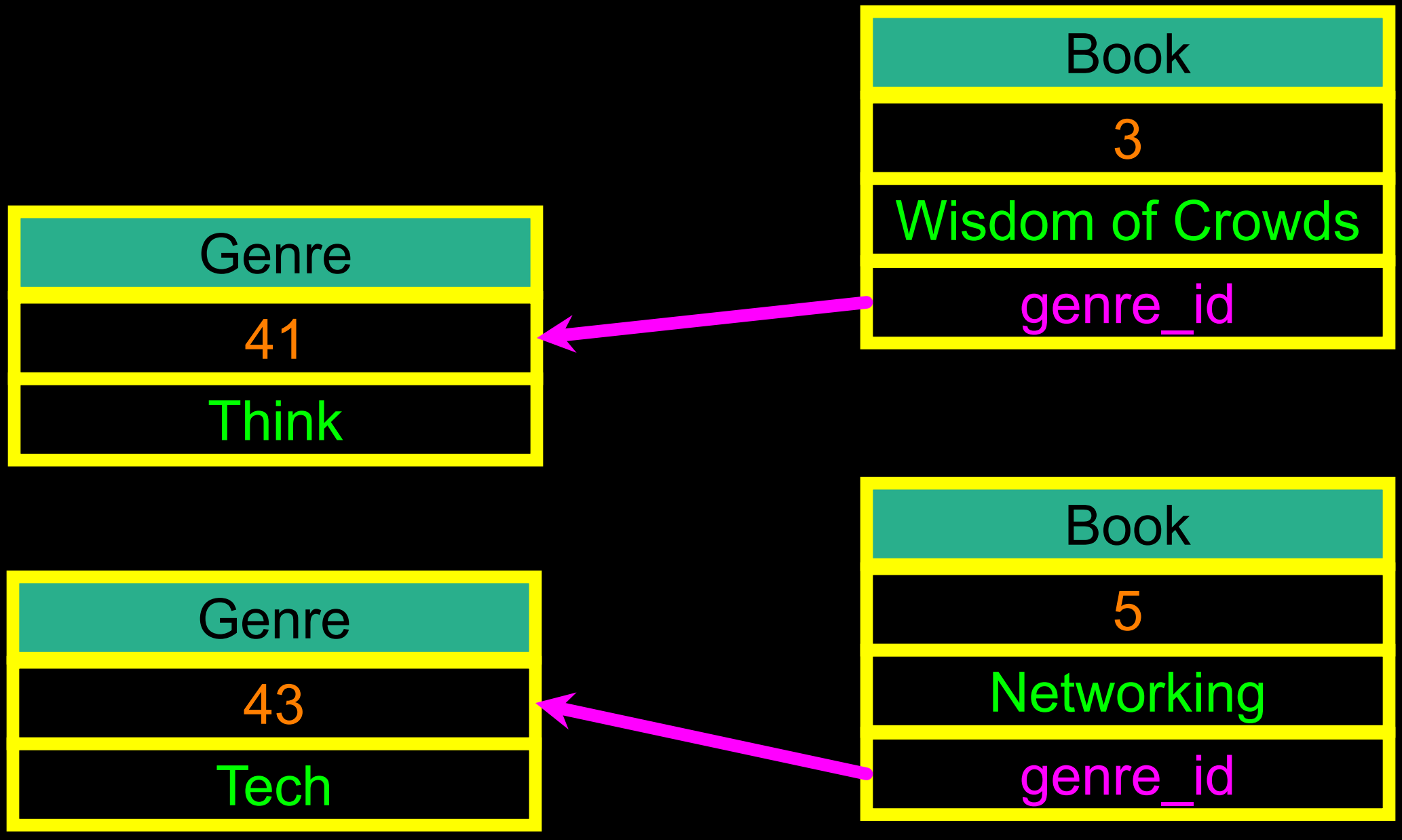
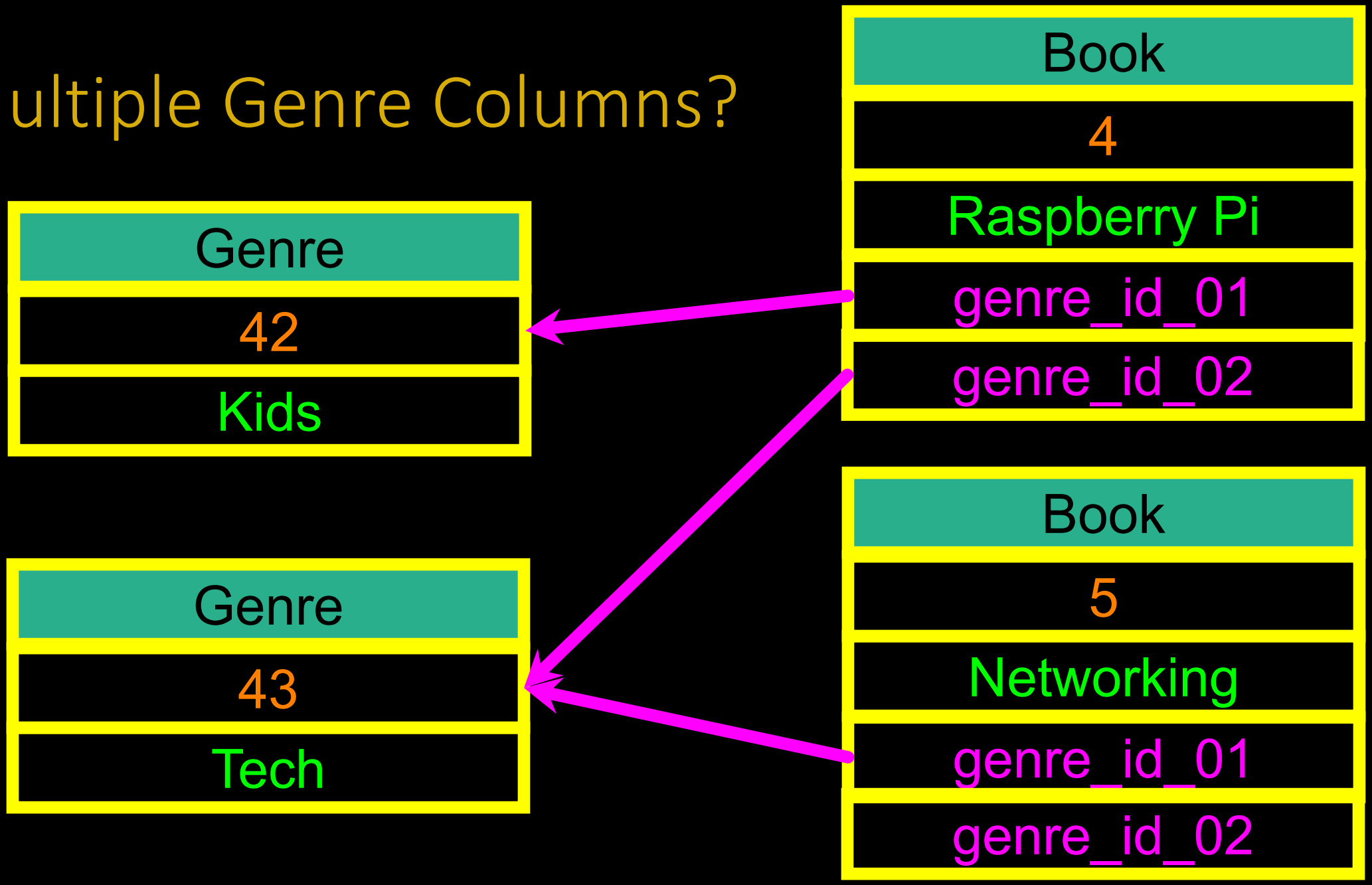


One-To-Many?

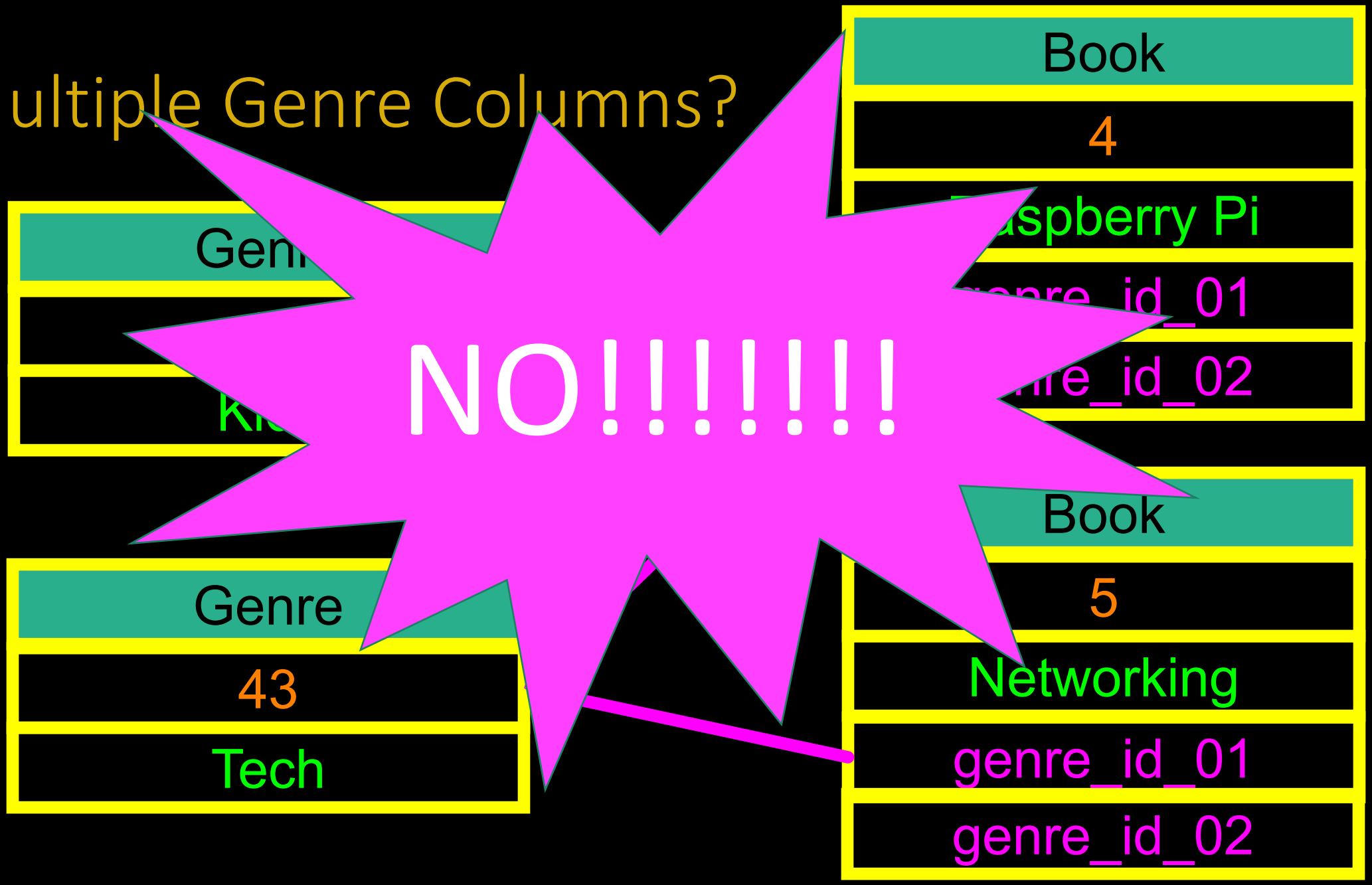



Book
3
Wisdom of Crowds
genre_id
Genre
41
Think
Book
5
Networking
genre_id
Genre
43
Tech

Multiple Genre Columns?



Multiple Genre Columns?

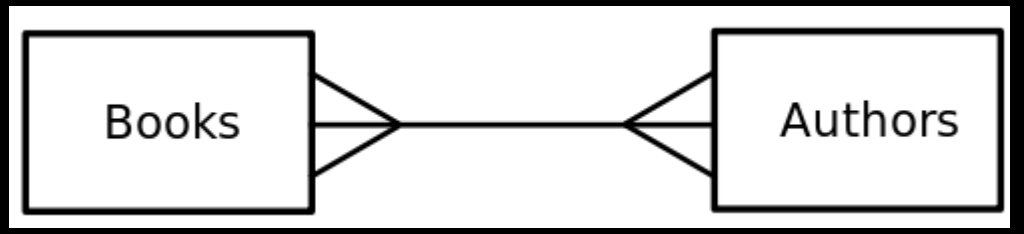


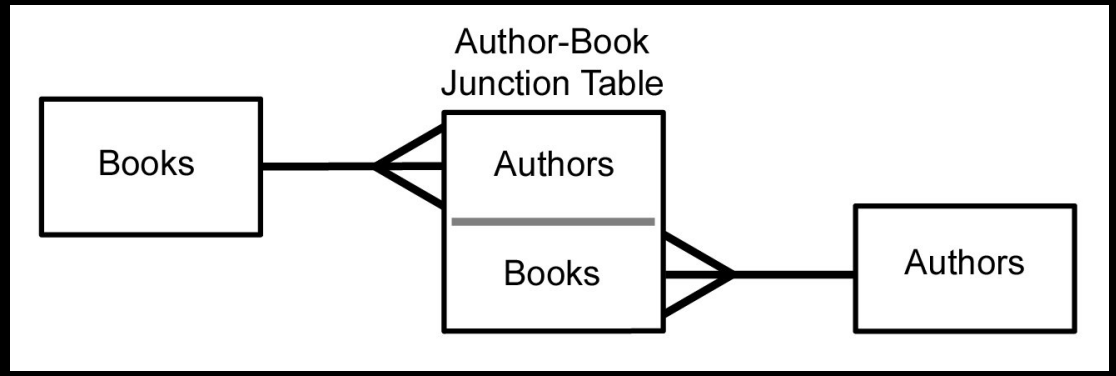
Many-To-Many

one_to_many + one_to_many = many_to_many

Many to Many

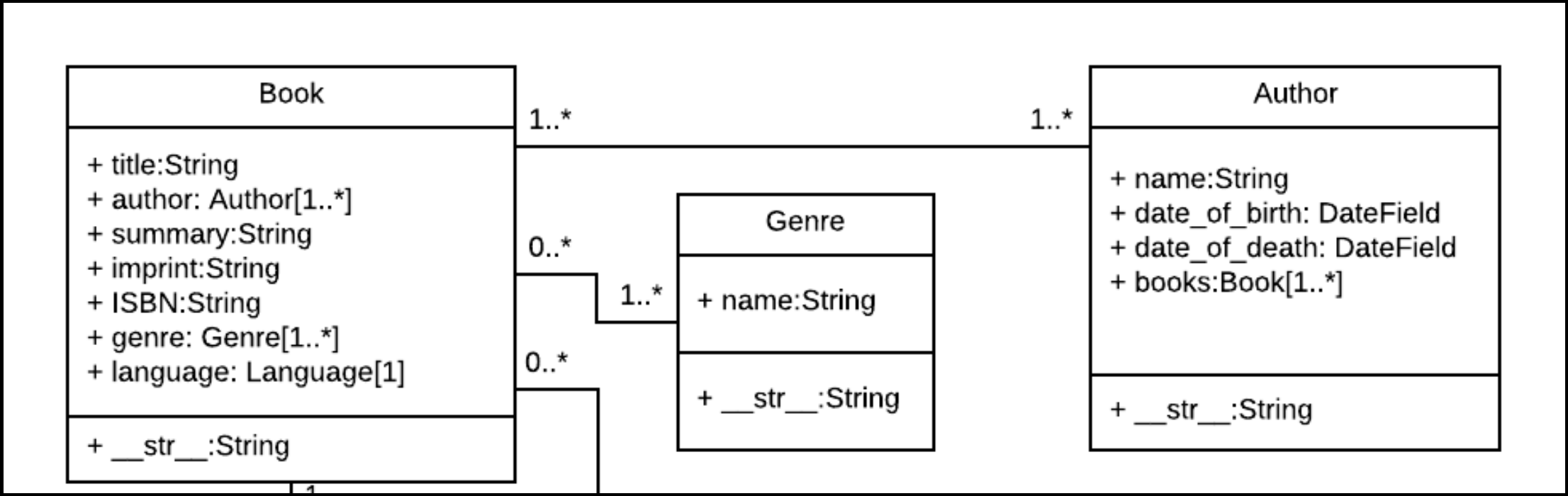
- Sometimes we need to model a relationship that is many to many.
- We need to add a “connection” table with two foreign keys.
- There is usually no separate primary key.
- We need two one-to-many relationships to capture a many-to-many



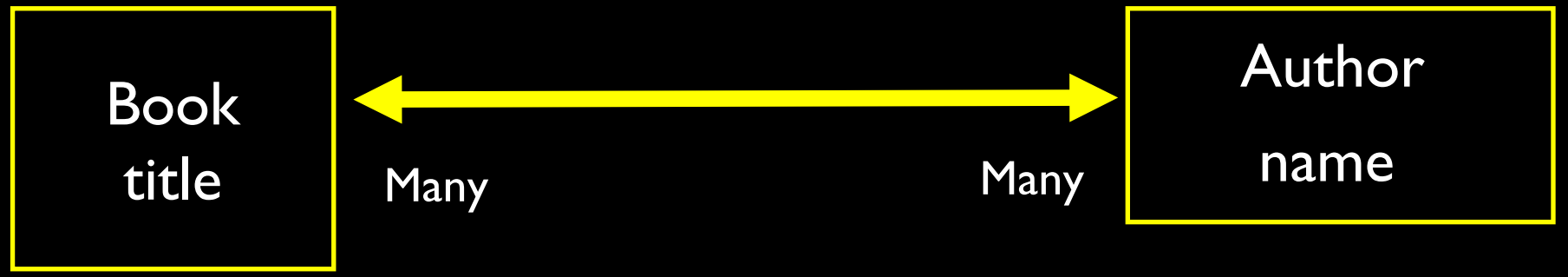


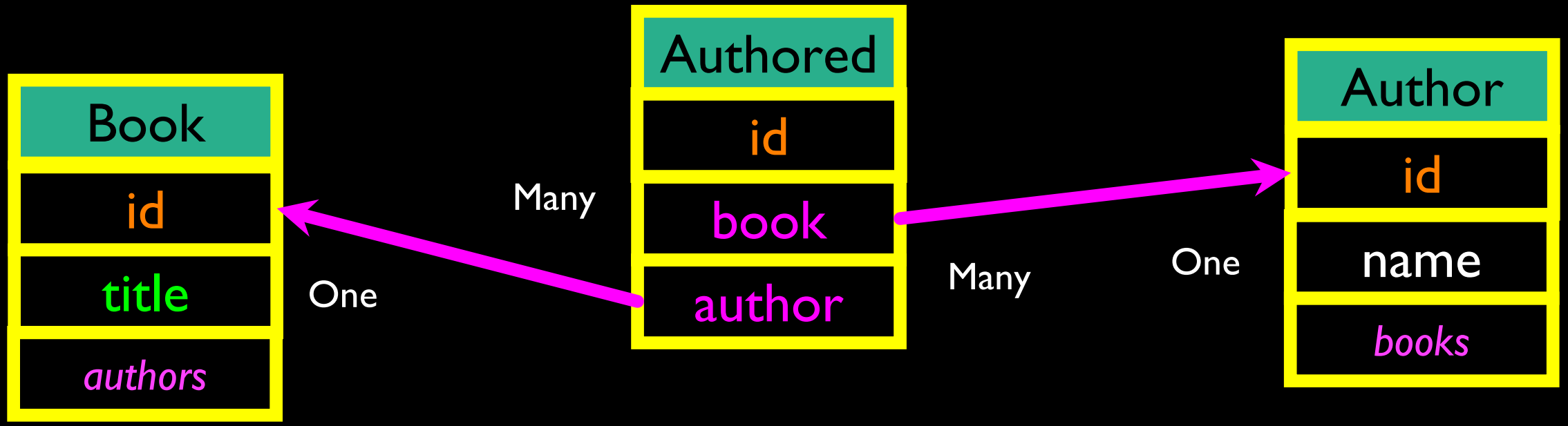
https://en.wikipedia.org/wiki/Many-to-many_(data_model)

Many-to-Many in Locallibrary




```
Legend:
1..*  Many with a minimum of 1
0..*  Many with a minimum of 0
```





Django calls this the "through" table

```python
from django.db import models

class Book(models.Model):
    title = models.CharField(max_length=200)
    authors = models.ManyToManyField('Author', through='Authored')

class Author(models.Model):
    name = models.CharField(max_length=200)
    books = models.ManyToManyField('Book', through='Authored')

class Authored(models.Model):
    book = models.ForeignKey(Book, on_delete=models.CASCADE)
    author = models.ForeignKey(Author, on_delete=models.CASCADE)
```

https://github.com/csev/dj4e-samples/blob/master/samples/bookmany/models.py

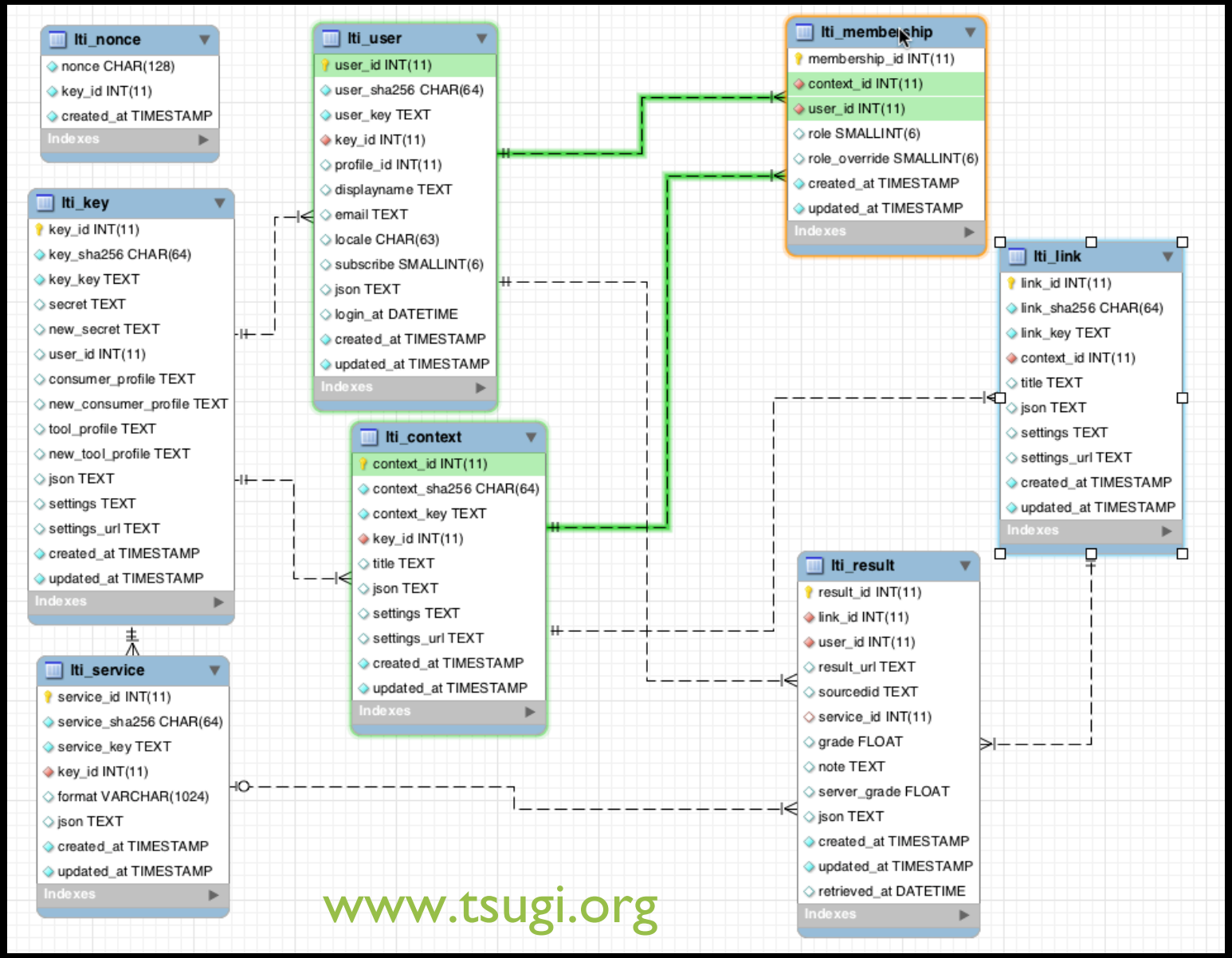
```
dj4e-samples$ python3 manage.py makemigrations
Migrations for 'bookmany':
  bookmany/migrations/0001_initial.py
    - Create model Author
    - Create model Authored
    - Create model Book
    - Add field book to authored
    - Add field books to author
dj4e-samples$ python3 manage.py migrate
Operations to perform:
  Apply all migrations: admin, auth, autos, bookmany, bookone,
contenttypes, favs, favsql, forums, gview, many, myarts, pics,
rest, sessions, social_django, tracks, users
Running migrations:
  Applying bookmany.0001_initial... OK
dj4e-samples$
```

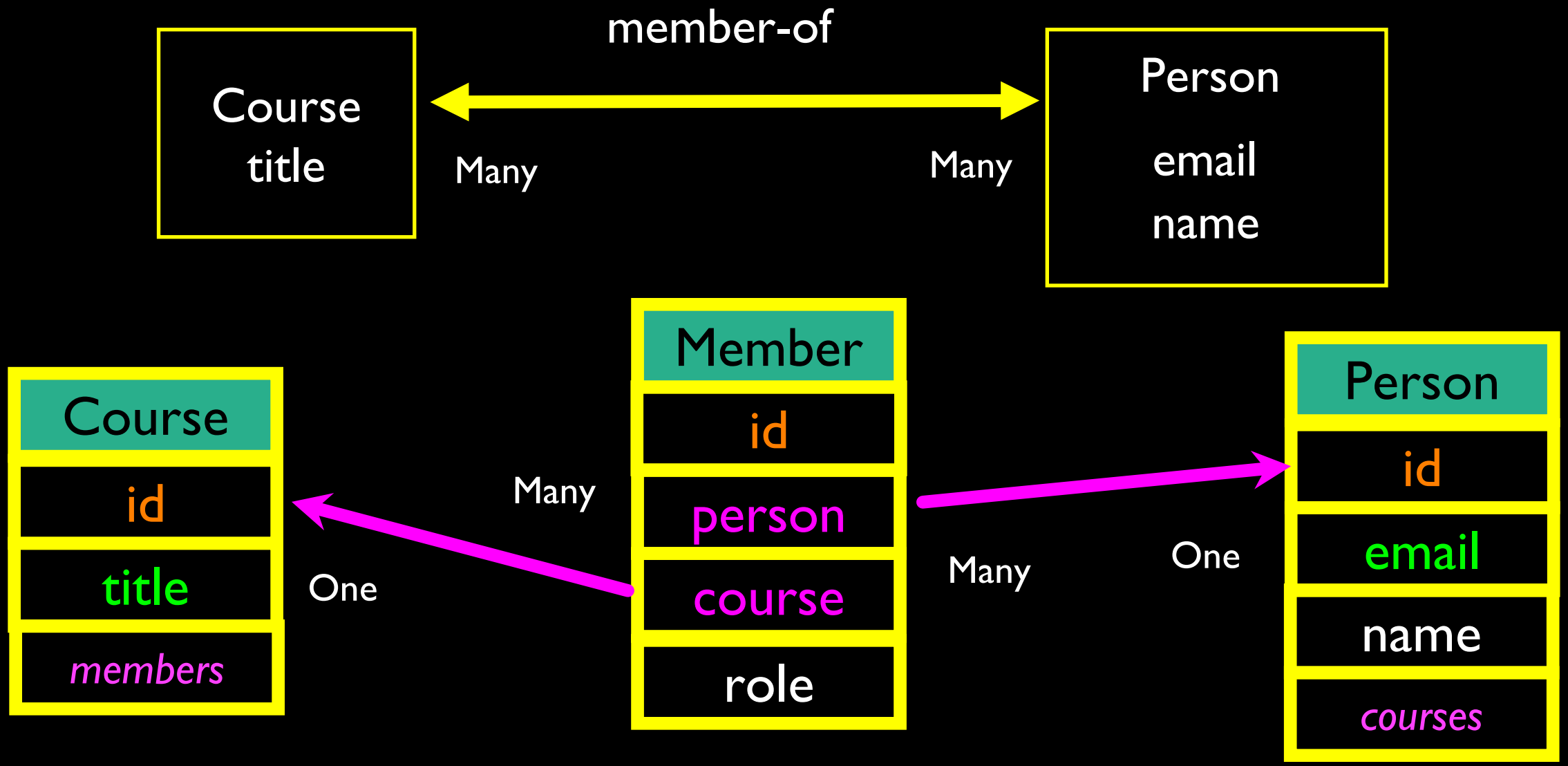
Remember that makemigrations only "does something" when you create or alter a models.py file. The migrate only "does something" when there are migrations that are not yet applied to the database. Also an application must be added to settings.py before these commands see the models.py file for an application.

```
dj4e-samples$ python3 manage.py shell
>>> from bookmany.models import Book, Author, Authored
>>> b1 = Book(title='Networking')
>>> b1.save()
>>> b2 = Book(title='Raspberry')
>>> b2.save()
>>> a1 = Author(name='Fontichiaro')
>>> a1.save()
>>> a2 = Author(name='Severance')
>>> a2.save()
>>> Authored(book=b1, author=a2).save()
>>> Authored(book=b2, author=a1).save()
>>> Authored(book=b2, author=a2).save()
>>> b1.authors.values()
<QuerySet [{'id': 2, 'name': 'Severance'}]>
>>> b2.author_set.values()
<QuerySet [{'id': 1, 'name': 'Fontichiaro'}, {'id': 2, 'name': 'Severance'}]>
>>> a1.books.values()
<QuerySet [{'id': 2, 'title': 'Raspberry'}]>
>>> a2.book_set.values()
<QuerySet [{'id': 1, 'title': 'Networking'}, {'id': 2, 'title': 'Raspberry'}]>
>>> quit()
dj4e-samples$
```

Another Example of Many-Many

Educational Technology


lti_nonce
nonce CHAR(128)
key_id INT(11)
created_at TIMESTAMP
Indexes
lti_user
user_id INT(11)
user_sha256 CHAR(64)
user_key TEXT
key_id INT(11)
profile_id INT(11)
displayname TEXT
email TEXT
locale CHAR(63)
subscribe SMALLINT(6)
json TEXT
login_at DATETIME
created_at TIMESTAMP
updated_at TIMESTAMP
Indexes
lti_membership
membership_id INT(11)
context_id INT(11)
user_id INT(11)
role SMALLINT(6)
role_override SMALLINT(6)
created_at TIMESTAMP
updated_at TIMESTAMP
Indexes
lti_key
key_id INT(11)
key_sha256 CHAR(64)
key_key TEXT
secret TEXT
new_secret TEXT
user_id INT(11)
consumer_profile TEXT
new_consumer_profile TEXT
tool_profile TEXT
new_tool_profile TEXT
json TEXT
settings TEXT
settings_url TEXT
created_at TIMESTAMP
updated_at TIMESTAMP
Indexes
lti_link
link_id INT(11)
link_sha256 CHAR(64)
link_key TEXT
context_id INT(11)
title TEXT
json TEXT
settings TEXT
settings_url TEXT
created_at TIMESTAMP
updated_at TIMESTAMP
Indexes
lti_context
context_id INT(11)
context_sha256 CHAR(64)
context_key TEXT
key_id INT(11)
title TEXT
json TEXT
settings TEXT
settings_url TEXT
created_at TIMESTAMP
updated_at TIMESTAMP
Indexes
lti_result
result_id INT(11)
link_id INT(11)
user_id INT(11)
result_url TEXT
sourcedid TEXT
service_id INT(11)
grade FLOAT
note TEXT
server_grade FLOAT
json TEXT
created_at TIMESTAMP
updated_at TIMESTAMP
retrieved_at DATETIME
Indexes
lti_service
service_id INT(11)
service_sha256 CHAR(64)
service_key TEXT
key_id INT(11)
format VARCHAR(1024)
json TEXT
created_at TIMESTAMP
updated_at TIMESTAMP
Indexes
www.tsugi.org



https://en.wikipedia.org/wiki/Many-to-many_(data_model)

```
from django.db import models

class Person(models.Model):
    email = models.CharField(max_length=128, unique=True)
    name = models.CharField(max_length=128, null=True)

class Course(models.Model):
    title = models.CharField(max_length=128, unique=True)
    members = models.ManyToManyField(Person,
            through='Membership', related_name='courses')
```

https://github.com/csev/dj4e-samples/blob/master/samples/many/models.py
https://docs.djangoproject.com/en/3.0/ref/models/fields/#choices

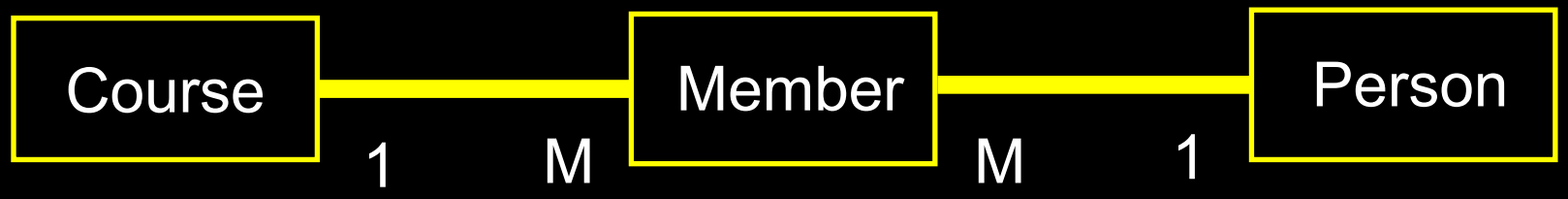
```
class Membership(models.Model):
    person = models.ForeignKey(Person, on_delete=models.CASCADE)
    course = models.ForeignKey(Course, on_delete=models.CASCADE)

    LEARNER = 1
    IA = 1000
    GSI = 2000
    INSTRUCTOR = 5000
    ADMIN = 10000

    MEMBER_CHOICES = (
        ( LEARNER, 'Learner'),
        ( IA, 'Instructional Assistant' ),
        ( GSI, 'Grad Student Instructor' ),
        ( INSTRUCTOR, 'Instructor' ),
        ( ADMIN, 'Administrator' ),
    )

    role = models.IntegerField(
        choices=MEMBER_CHOICES,
        default=LEARNER,
    )
```

```
>>> from many.models import Person, Course, Membership
>>> p = Person(email='ted@umich.edu')
>>> p.save()
>>> c = Course(title='Woodcraft')
>>> c.save()
>>> c.id
6
>>> c.members.values()
<QuerySet []>
>>> m = Membership(role=Membership.INSTRUCTOR, course=c, person=p)
>>>  m.save()
>>>  m.id
15
>>> m.course_id
6
>>> c.members.values()
<QuerySet [{'id': 3, 'email': 'ted@umich.edu', 'name': None}]>
>>> p.courses.values()
<QuerySet [{'id': 6, 'title': 'Woodcraft'}]>
```



Demo Batch Loading from CSV

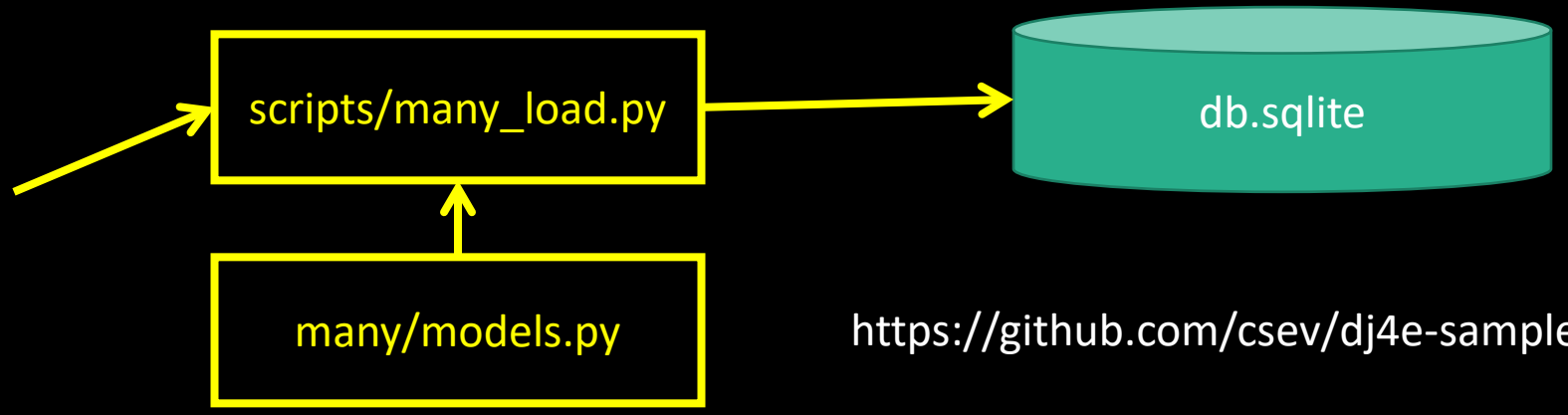
https://github.com/csev/dj4e-samples/tree/master/samples/scripts

https://django-extensions.readthedocs.io/en/latest/runscript.html

Loading Data From A File

- Sometimes we need to pre-load data into our Django database
- This data might come from an API or file
- We need to write a Python program to function like the Django shell

many/load.csv
jane@tsugi.org,I,Python
ed@tsugi.org,L,Python
sue@tsugi.org,L,Python
ed@tsugi.org,I,Django
sue@tsugi.org,L,Django
ed@tsugi.org,I,SQL
jane@tsugi.org,L,SQL



https://github.com/csev/dj4e-samples

Installing django-extensions

```
dj4e-samples$ pip3 install django-extensions
Requirement already satisfied: django-extensions in
/Library/Frameworks/Python.framework/Versions/3.6/lib/python3.6/site-packages
Requirement already satisfied: six>=1.2 in
/Library/Frameworks/Python.framework/Versions/3.6/lib/python3.6/site-packages
dj4e-samples$
```

Note that this is installed already in dj4e-samples but for a new project you will need to install it yourself and edit **settings.py**

https://django-extensions.readthedocs.io/en/latest/runscript.html

Include Extensions in Project Settings

dj4e-samples/settings.py

```
INSTALLED_APPS = [
    'django.contrib.admin',
    'django.contrib.auth',

[ ... ]

    # Extensions - see requirements.txt
    'django_extensions',
    'crispy_forms',

[ ... ]

    'home.apps.HomeConfig',

    # Sample Applications - don't copy
    'hello.apps.HelloConfig',
    'getpost.apps.GetpostConfig',
    'users.apps.UsersConfig',

[ ... ]
]
```

Make a scripts folder

```
dj4e-samples$ mkdir scripts
dj4e-samples$ touch scripts/__init__.py
```

We place empty `__init__.py` files in folders to indicate to Python that they contain files that hold modules and as such are suitable for importing into a Python application.

http://effbot.org/pyfaq/what-is-init-py-used-for.htm

The Data File

```
dj4e-samples$ cat many/load.csv
jane@tsugi.org,I,Python
ed@tsugi.org,L,Python
sue@tsugi.org,L,Python
ed@tsugi.org,I,Django
sue@tsugi.org,L,Django
ed@tsugi.org,I,SQL
jane@tsugi.org,L,SQL
dj4e-samples$
```

https://en.wikipedia.org/wiki/Cat_(Unix)

scripts/many_load.py

```
import csv  # https://docs.python.org/3/library/csv.html

from many.models import Person, Course, Membership

def run():
    fhand = open('many/load.csv')
    reader = csv.reader(fhand)

    Person.objects.all().delete()
    Course.objects.all().delete()
    Membership.objects.all().delete()

    for row in reader:
        print(row)

        p, created = Person.objects.get_or_create(email=row[0])
        c, created = Course.objects.get_or_create(title=row[2])

        r = Membership.LEARNER
        if row[1] == 'I' : r = Membership.INSTRUCTOR
        m = Membership(role=r,person=p, course=c)
        m.save()
```

```python
class Membership(models.Model):
    person = models.ForeignKey(Person, on_delete=models.CASCADE)
    course = models.ForeignKey(Course, on_delete=models.CASCADE)

    LEARNER = 1
    IA = 1000
    GSI = 2000
    INSTRUCTOR = 5000
    ADMIN = 10000

    MEMBER_CHOICES = (
        ( LEARNER, 'Learner'),
        ( IA, 'Instructional Assistant' ),
        ( GSI, 'Grad Student Instructor' ),
        ( INSTRUCTOR, 'Instructor' ),
        ( ADMIN, 'Administrator' ),
    )

    role = models.IntegerField(
        choices=MEMBER_CHOICES,
        default=LEARNER,
    )

    def __str__(self):
        return "Person "+ str(self.person.id) + " <--> Course " + str(self.course.id)
```

```
dj4e-samples$ python3 manage.py runscript many_load
['jane@tsugi.org', 'I', 'Python']
['ed@tsugi.org', 'L', 'Python']
['sue@tsugi.org', 'L', 'Python']
['ed@tsugi.org', 'I', 'Django']
['sue@tsugi.org', 'L', 'Django']
['ed@tsugi.org', 'I', 'SQL']
['jane@tsugi.org', 'L', 'SQL']
dj4e-samples$
```

```
for row in reader:
        print(row)

        p, created = Person.objects.get_or_create(email=row[0])
        c, created = Course.objects.get_or_create(title=row[2])

        r = Membership.LEARNER
        if row[1] == 'I' : r = Membership.INSTRUCTOR
        m = Membership(role=r,person=p, course=c)
        m.save()
```

Many-to-Many in the Django Shell

```
dj4e-samples$ python3 manage.py shell
>>> from many.models import Person, Course, Membership
>>> Person.objects.values()
<QuerySet [{'id': 1, 'email': 'jane@tsugi.org', 'name': None},
 {'id': 2, 'email': 'ed@tsugi.org', 'name': None},
 {'id': 3, 'email': 'sue@tsugi.org', 'name': None}]>
>>> x = Person.objects.get(pk=1)
>>> x.email
jane@tsugi.org
>>> x.courses.values()
<QuerySet [{'id': 1, 'title': 'Python'},
 {'id': 3, 'title': 'SQL'}]>
>>> y = Course.objects.get(pk=2)
>>> y.title
'Django'
>>> y.members.values()
<QuerySet [{'id': 2, 'email': 'ed@tsugi.org', 'name': None},
 {'id': 3, 'email': 'sue@tsugi.org', 'name': None}]>
>>>
```

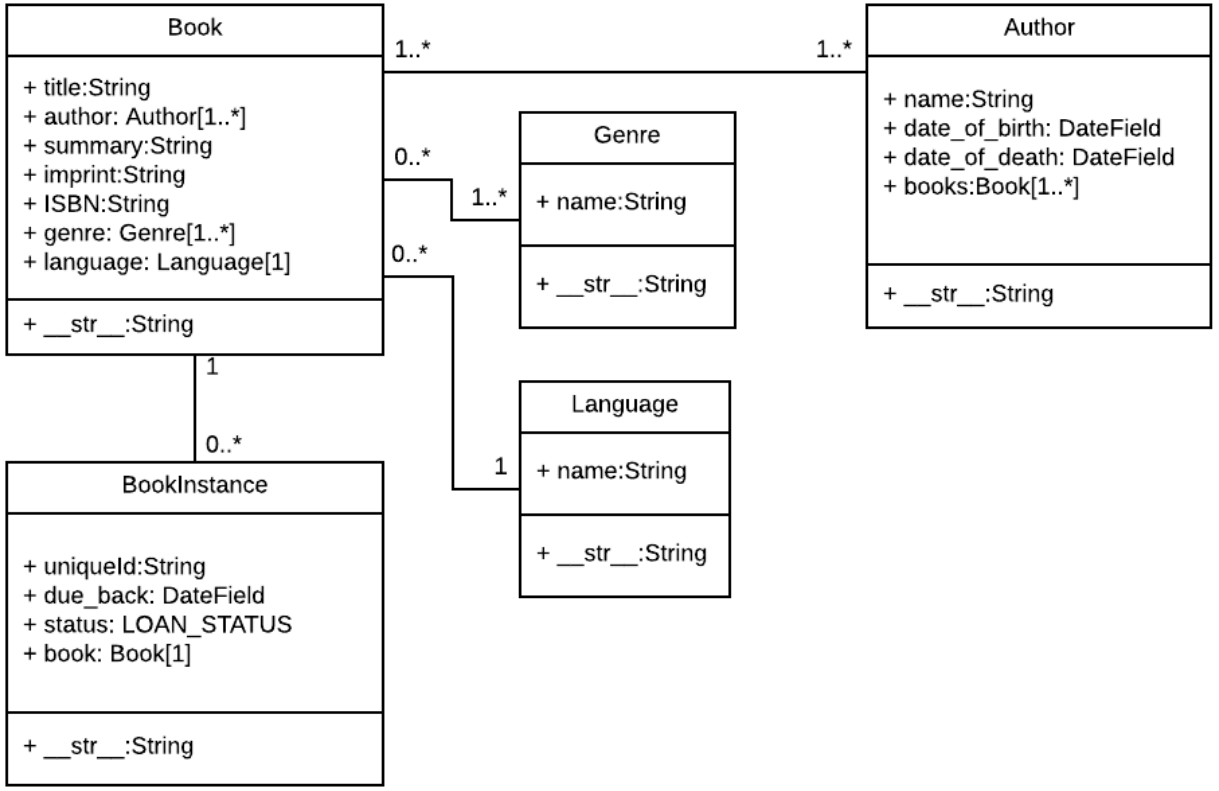
Looking at the "through" table

```
>>> y = Course.objects.get(pk=2)
>>> y.membership_set.all().values()
<QuerySet [
{'id': 4, 'person_id': 2, 'course_id': 2, 'role': 5000},
{'id': 5, 'person_id': 3, 'course_id': 2, 'role': 1}
]>
>>>
```

https://stackoverflow.com/questions/2005953/access-fields-in-django-intermediate-model

Summary

- Data modelling is both simple and complex
- "Don't allow string data to be replicated"
- We use keys and relationships
  - Primary key
  - Foreign key
- Relationships
  - One-to-Many
  - Many-to-Many



Acknowledgements / Contributions

Initial Development: Charles Severance, University of Michigan School of Information

Insert new Contributors and Translators here including names and dates

Continue new Contributors and Translators here